A Daylighted Room

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University of Idaho Bookstore
Building Description

Location: Moscow, Idaho
North 46°
West 117°
Elevation 2556 ft

- Concrete masonry construction with flat roof.
- Two relatively small windows on the west façade with intermittent glass block arrangement two feet above the top of the windows.
- Vestibule entrance of five standard glass pane doors with side lights and transoms.
- Four office spaces to the south, each with south-facing windows to the exterior and interior windows overlooking the main retail floor.

Space: Retail & Checkout Spaces
Building Description

Existing lights:
- Wall-mounted track lighting at window displays and Vandal Gear wall
- Suspended direct fixtures with fluorescent lamps and reflector accessories over counter spaces and at back wall
- General 2x4 fixtures, four fluorescent lamps and gridded reflector accessories, flush with ceiling tiles

Finishes & Luminance:
- Flat yellow paint on CMU walls: 24 fL
- White acoustical ceiling tiles with white trim: 48 fL
- Brown commercial carpet: 24 fL
- 4x4 red-brown ceramic tile: 17 fL
- Light wood finish gondolas & shelves: 74 fL

Climate Data

Estimated daylight hours per season:
Performance Analysis

Current Electric/Daylighting Design:
FEB. 8th @ 2:20 pm

Per Agi32 Software:
- Average Illuminance (FC): 74.5
- Maximum Illuminance (FC): 158

Per Manual Light Meter:
- Average Illuminance (FC): 47.6
- Maximum Illuminance (FC): 95

Performance Analysis

Interior Electrical/Daylighting

Well distributed amount of light throughout the space:

- Most of light in the space is from the electric light fixtures and lamps
- The front of the store opposite the vestibule suffers from intense glare
Performance Analysis

Daylighting Design:
FEB. 8th @ 4:20 pm

Average Illuminance (FC): 1.32
Maximum Illuminance (FC): 16.7

Performance Analysis

Interior Daylighting

Inadequate distribution of daylight throughout the entire space

- The North side is faced with incredible amounts of gloom
- What window openings there are create intense glare
Performance Analysis

Glare Analysis

- Glare is present on the west side of the structure where there are only two windows
- Most of the display furniture is polished and adds to the glare
- Schlier Glare (yes) with a ratio of 4.71:1

Redesign Proposal

Goals:
- Achieve an adequately daylit space
- Keep essential wall space for merchandise display
- Keep glare to a minimum
- Limit the amount of heat gain to a space in the summer months

Methods:
- Create a series of vertical monitors
- Replace the current fixtures and lamps with LED tube lamps
Redesign Performance Analysis

Daylighting Redesign:

Average Illuminance (FC): 29.50
Maximum Illuminance (FC): 134

Redesign Performance Analysis

Interior Daylighting:
Performance Analysis

Glare Analysis:

- Glare is greatly reduced in the re-design of the bookstore
- Schiller glare (maybe) with a ratio of 2.48:1

Performance Analysis

Total exterior illumination ($FC_{ext}$) required to achieve recommended Daylight Factor:

<table>
<thead>
<tr>
<th>Task/Space</th>
<th>Illumination ($FC_{int}$)</th>
<th>Hours of Operation</th>
<th>Recommended Daylight Factor (DF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counters/Entry</td>
<td>500 Lux or 47 FC</td>
<td>8am-9pm</td>
<td>1% or 0.01</td>
</tr>
<tr>
<td>Retail Floor</td>
<td>750 Lux or 70 FC</td>
<td>8am-9pm</td>
<td>5% or 0.005</td>
</tr>
</tbody>
</table>

$FC_{ext} = FC_{int} / DF$

- For Counters/Entry: $FC_{int} = 47 / .01 = 4700$ FC
- For Retail Floor: $FC_{int} = 70 / .005 = 1400$ FC
Performance Analysis

Available Illumination @ 46° Latitude

- Highest illumination from 10am-2pm
- Top-lighting allows for maximized illumination throughout the year

Daylighting Aperture Sizing:
- Existing Side Lighting – Windows and Vestibule
  - 308 SF of Existing Glazing
- New Top Lighting – Vertical Monitors
  - 1032 SF of Glazing Added

Daylight Factors Calculations:
- Total Daylight Factor for Redesign: 12%
  - $DF_{Average} = 0.2 \left( \frac{A_{Glazing}}{A_{Floor}} \right)$
    - Existing Glazing: $DF_{Average} = 0.2 \times \left( \frac{308}{616} \right) = 10\%$ DF
    - New Top-Lighted Glazing: $DF_{Average} = 0.2 \times \left( \frac{1032}{10,121} \right) = 2\%$ DF
Energy Savings

- By replacing the 600+ fluorescent lamps with high efficiency LED tubes the savings will be great over the lifetime of the building.

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Energy

According to the LBL Nomograph there should be a savings of 63% per year with the addition of sky lighting.

An annual savings of over 15,000 due to daylighting.
Conclusion

Upon entering the space, we observed that it was not adequately daylighted. There is enough daylight at the entrance, but the retail floor was primarily lighted by electric fixtures.

In the original design, energy was being wasted. Because the electric lights were the main source of illuminance during the daytime, energy was being used not only for lighting but also for cooling and ventilation.

Providing the space with top lighting allows for daylight without occupying the wall space needed for merchandise. It also allows for ventilation in the summer months and solar heat gain in the winter.

Thank You

¿Questions?

“Day man, fighter of night man”